"Two Sciences...." Part II: Mental Life and the Language of Science

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ABSTRACT. Isaac Newton formulated four rules for observing nature that have served science well in the quest for an objective description of reality. At the same time, he was searching for a fifth rule, a functional complement to the structural rules that would make possible a science of subjectivity. Drawing on the ideas of C. S. Lewis and William James, William Stephenson brought this fifth rule to maturity. In Part II of this "Two Sciences..." essay, we propose a language for thinking about these concepts from the perspective of psychological science using the language of quantum mechanics.

In Part I of "Two Sciences..." (Knight and Rupp 1999) we recapitulated the development of objectivity and subjectivity as worldviews and described complementarity as a new worldview where object and subject are not independent, but rather inter-dependent while remaining mutually exclusive. We also argued, along with Lewis and Stephenson, that there is a participatory nature to knowing and that consciring rather than consciousness better reflects this inherently dynamic quality. This is particularly important for psychology where consciring is self-referential. In Part II we examine the importance of language in shaping worldviews and propose a way of translating complementarity and quantum mechanics into familiar psychological concepts.

First we review the language used to construct the classical worldview of Newton. From this perspective we will be able to glimpse the reasons for Bohr's complementarity revolution and the emergence of quantum physics. Interestingly, we will also see that Newton anticipated a science of subjectivity with a fifth rule of science that he unfortunately never fully developed.

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Newton's Rules and Classical Mechanics

What are these Rules? Nothing more than ways to approach the world and structure observations. Imagine a group of scientists as parliamentarians, for they, too, are concerned with laws — not those established to "make" order in the world, but those of nature. These scientists, however, are unique, at least in relation to typical decision-making bodies. Rather than imposing their will upon the world by passing laws, they are committed to recognizing laws that already exist. So, unlike other legislators who can get away with writing "new" laws, the scientist is more a reader — trying to decipher the criminal and civil codes of nature.

This quest for the grail of nature's laws is not new. The Scholastics of medieval times, for example, wore down quills and filled many a sheet of vellum on the subject. Just as the later scientists have Newton's Rules to guide their recognition of nature's wiles and ways, the Scholastics operated within a set of guidelines for discovery: the Bible, into whose story all observations of the world were made to fit. But the Scholastics' similarity with the scientists ends with the appeal to a higher power (or at least a text purported to be the inarguable word of a higher power) for validation. This assumption of infallibility was the error of the Scholastics. Refutation, falsifiabilty is the cornerstone of science (Stephenson 1987).

What Newton offered was a different set of rules for discovery, a way to approach nature on nature's own terms, rather than on the terms of a theology overlaid on nature. Rather than provide a bible as an answer book for the scientists, he described a way to watch nature reveal her "Bible." Here's how Newton proposed that the new parliament of scientists conduct their investigations of nature's laws. He provided four basic rules of consequence, which give the scientist a way to make observations. In science this means that the rules governing methodology give structure and meaning to the conditions of observation.

The First Rule is **Be mindful of the innate *simplicity of nature's laws*.** Don't unnecessarily complicate things. Be parsimonious in hypothesizing. The Second Rule is **Given the simplicity of laws, look for *uniformity in nature*.** If one sees similar effects, look for similar causes. The Third Rule **Given innate simplicity and uniformity in nature, be both brave and tentative about *generalizing*.** If a scientist begins to notice that certain properties emerge in the course of particular experiments (observations), look for those same properties to appear in similar experiments. The Fourth (and until recently final) Rule is **If a scientist following the first three rules discovers some particular laws governing nature, those laws should be accepted as true until additional experiments, conducted according to the same rules, provide contradictory observations** (Newton trans. 1934). These rules have served scientists well. Since Newton, our understanding of the world has increased many fold. Not too long ago, many believed that it would be possible to know nature's entire bible by following these rules. One by one, scientists have mapped the frontiers of nature, from the celestial music of the spheres to the structure and formation of the molecule.

From the first, Newton seemed to know that his rules were incomplete, despite their elegance and efficacy. They provide a way to study the world of objectivity, that is, structural information (Mackay 1969). His rules are hypotheses of sorts, but they are more on the order of beliefs, capable of neither proof nor disproof. Newton's Rules are still of value, because they worked, and, as the pragmatist William James said, "The truth is what works" (Hunt 1993). They had a source, and that source was of nature. Alone, though, these first four rules do not provide a way to study a special chapter in nature's text. Newton's Fifth Rule, long "asleep among his papers," concerned ways to get at the source of ideas, feelings, thoughts — in short, a scientific manner of approaching mental life.

Newton's Fifth Rule

What Newton was struggling with was a way to approach functional information (Mackay 1969). He sought to provide an additional injunction governing the methodological actions of the scientist that would complement the first four rules and allow for examination of such phenomena as, for example, Newton himself coming up with his theory of gravity and its laws. Simply, Newton sensed that such a statement as "I believe in (something)" was as valid a natural phenomenon as the motions of the planets, and therefore of interest to the scientist.

This kind of phenomenon, which we call subjective, does not lend itself to the hypothesis testing deductivism applicable to structural phenomena. Titchner's structuralism was an attempt to objectify "the contents of the mind" through introspection. This is a pertinent example of the inapplicability of approaching the functional information of the 'mind' from a strictly mechanistic objectivism. The inherently functional nature of the mind, to paraphrase James — its dynamic processing, renders all efforts to train subjects to be objective about their subjectivity an exercise in futility. Observers cannot be separated from that of which they are a part any more than hydrogen can be separated from oxygen without rendering the study of fluidity moot. This is true of both minds and atoms. As Newton says, "I sense that I am thinking." Thought itself is an hypothesis, but of a special kind. How, then, to approach these subjective hypotheses, when by their very nature they do not lend themselves to the methodological rigors so demonstrably powerful in examining objective, testable propositions?

William Stephenson, psychologist and physicist, brought to maturity the previously incomplete Fifth Rule. Central to Stephenson's interpretation of Newton's Fifth Rule is the C. S. Lewis concept of consciring, a dynamic participatory communion of transitive thought, and the concept of concourse — "a random collection of self-referable statements about something" (Stephenson 1994, 6). These are the "quantumstuff" (Herbert 1985, 40) of subjectivity — a population of stimuli upon which the dynamic focusing of the psyche can work. (See also Brenner, Aucion and Xiaoming 1998.) Examples of such populations range from a collection of statements about women in H.L. Mencken's dictionary of quotations to a set of postcards depicting little children, to strips of colored paper. In practice, any set of stimuli that lends itself to communication about the self, by way of feeling, could constitute a concourse. From the outset, Stephenson was after the raw essence of a Jamesian transitive mental life.

> The first principle in subjective science stems from philosopher Charles Peirce, who observed that ideas spread *ad libitum* ... An objective fact remains singular, a stick in the mud. Self-reference is like blossoms on a cherry tree, spreading on every branch, every brachiate, in boundless profusion. ... What we are about, in Q-methodology, is to recognize, for the first time in history, the fundamental significance of this self-referent proliferation. (Stephenson 1994, 3-5)

Subjectivity is consciring; it is transitive thought with self-reference and as such is indeterminate with infinite possibilities. What Stephenson accomplished was to operationalize subjectivity using Q-sorting where an individual's consciring is made substantive in the form of operant choices. James described the difference between transitive and substantive thought as, like a bird flitting and perching. The perching, as a complement to flitting, is a collapsing of the infinite into the finite. As Brown (1999, 8) explains,

> In the silence prior to an utterance, virtually anything could be said, but as in the collapse of the wave packet in quantum theory, at the moment of utterance all potentiality vanishes and one thought assumes a probability of 1.00.

From subjective consciring comes objective measurable operant behavior, which psychologists would describe as choice behavior. It is important to note here that the use of the word *choice* in this context is not meant to imply conscious volition. There is never a need to postulate a mind, or as Skinner would say, an initiating agent to explain operant choice behavior, any more than there is a need to postulate a thinker to explain thinking. (Knight, Frederickson and Martin 1987; Stephenson 1980) While this methodology for a subjective science does not deny objectivism, it is more than mere subjectivism or philosophy of mind. "It is a mathematical-statistical key to what everyone calls 'mind,' paralleling that of Einstein, Heisenberg and Schrödinger for [physical] matter." (Stephenson 1994, 2)

But we are getting ahead of the game, and the discussion at this point begs for a concrete example — a demonstration of Stephenson's method at work. In Part III of "Two Sciences..." we will present such an example.

However, in the remainder of this paper it is necessary to draw more specific parallels between the similar theoretical and methodological conundrums facing both quantum physics and psychology.

The Principle of Behavioral Complementarity

The evolutionary purpose for a central nervous system is to enable the organism to anticipate the consequences of releasing the energy stored in the muscles. Within the brain there is a model or representation of "me" and "not-me," of that which I can cause to move simply by thinking about it, and that which I can not move by thought alone. The developing human spends most of life elaborating the neural representations of these two primary cognitive schemata and their interactions. The child learns that simply attending to *the hand*, moving it in the mind, is followed by the movement of the hand itself, therefore the hand is "me." Attending to *an object* and moving it in the mind is not followed *by the object's* movement, so the object is "not-me." Very early in life, however, the child learns to use the "me" to affect the "not-me." The child **cannot** cause the object to move by attending to it, but if it releases the energy in the muscle of the arm then the object can be moved. Notice that within the central nervous system the "me" schema is brought in contact with the "not-me" schema before the effector muscle is activated.

In both of these situations, the movement of the hand and the movement of an object, the action is rehearsed subjectively first. There is a hand representation and an object representation in the brain and they are moved within the mind first, in anticipation of their movement outside of the brain. This is the principle of behavioral complementarity. There exists a complementarity between anticipatory "doing" and the doing itself. Neither form of doing could exist without the other. The hand touching the object derives from a mental image of the hand touching the physical object. These representations are themselves built from the if/then contingencies of experience with the hand touching the object. Behavioral complementarity is interactive with anticipatory actions built from the physical behavior they make possible.

The Quantal Decision

If, at its most elementary, the function of neural representation is to simulate the future and make all-or-none decisions with regard to the activation of effector muscles, then it seems to us that this is an indivisible cognitive element. It is a thought quantum, a discrete quantal decision point where the myriad possible futures collapse into a single action. In quantum theory matter and energy are simultaneously particles and waves existing in a mixed state, called a probabilistic wave packet, until measured. The act of observation then is what collapses the probabilistic wave packet. In like fashion representational thought in the form of simulated futures exists only probabilistically. The quantal decision occurs at the point where the wave packet collapses and bursts of behavior become manifest.* It is also interesting to note that the study of James, particularly with regard to transitive and substantive thought greatly influenced Bohr in thinking about quantum mechanical principles and complementarity (Folse 1985). We also see the nature of quantal decisions in James's description of attentionality and will,

> The essential achievement of the will, in short, when it is most 'voluntary,' is to ATTEND to a difficult object and hold it fast before the mind... Effort of attention is thus the essential phenomenon of will (James 1890, 561-62).

There is an important quantum science lesson in this description: it sounds like James is talking about attending to a single object when in fact he is very explicit in defining attentionality as a decision, a choice of what to attend to and what to ignore. All behavior is choice behavior. Attending is by definition both a looking and a not-looking. At an intersection for example the choice of looking left first is also a choice of not looking to the right. This is complementarity. Looking to the left is defined as much by what it is not as by what it is. Focusing on one thing excludes focusing on something else. Herrnstein recognized this when he formulated his quantitative law of effect. He was studying choice behavior where subjects tend to match their rate of responding to one activity or another based on the corresponding rate of reinforcement for each activity. The problem was how to generalize his observations to behavioral situations where there was but a single activity and thus no choice to be made. What Herrnstein realized is that all behavior is choice behavior. Even the rat in a Skinner box is choosing to press the lever or to do something else (McDowell, 1982).

The Fractal Nature of Thought

If we conceptualize discrete choice behaviors as the quanta of mental life we see that decisions swim in a probabilistic mixed-state, a transitive stream of thought. At the binary choice point the wave-packet collapses, subjectively, as an anticipatory doing.

What is most apparent from the extensive research literature on choice behavior is that quantal decisions are always binary. For example, the optometrist creates a binary loop, "better like this or like this," to obtain comparative judgments, with each quantal decision becoming a point in a much larger more complex picture, but the loop itself branches from quantum units that are simple and indivisible. The mathematical description of iterative branching from quantal choice points like this is called fractal geometry. Fractals are trees, mountains, clouds, erosion, a geometry of change through space/time. Fractals are recognizable from their self-similarity, any part of it reveals all of it; and their recursive nature, instructional code looping back on itself. The epitome of complementarity is revealed in the complexity and simplicity of fractals. So much so that having two separate words seems contradictory. In fractals we see complementarity revealed because we feel their *simplexity*.

A complementarity example of fractal similarity for physics and psychology involves the unobservable constructs of gravity and mind. Recall that complementarity has the defining characteristics of mutual exclusivity and inter-dependence. This is readily apparent with gravity, for example. In a solar system the center-of-gravity, a nonexistent point towards which everything is attracted, and the motion of planets, asteroids, etc., are the two complementary aspects of the gravitational system. One is physical, the other abstract, both real, but mutually exclusive. The elements of the system determine the location of the center-of-gravity and as a consequence revolve around it — inter-dependence. The mind, an equally ephemeral construct, manifests its own nonexistent center, the self (or consciousness) which Daniel Dennett (1992) has described as the center of narrative gravity. Episodic memories of self, physical in their composition, are stories of past lives, an ancestry of selves made coherent by their communality. Inter-dependent from quixotic recall and restorying, new memories like new planets change everything.

Q-sorts have an inherent fractal nature about them. What looks like chaos — quantal decisions for a multitude of items and conditions of instruction — is revealed as simple factor structure. Fractals describe the arterial networks, the air channels of the lungs, and the neuronal nets of the brain. It seems to us no less appropriate to describe all of thought as the self-similar iteration of a quantal decision.

There is really nothing new here. A restatement of Newton, James, Bohr, and Stephenson using metaphors of particular relevance to contemporary psychology. The phrases behavioral complementarity, quantal decision, the fractal nature of thought are new bottles for old wine. But do not underestimate the worth of a new bottle or the power of a different metaphor.

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